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AUTHOR Mitchell, Charles W.

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ABSTRACT

The study was designed to assess the effects of three different instructional strategies of teaching science methcds on selected attitudes and perceptions held by 30 prospective elementary school teachers, as well as the effects of these instructional strategies on children's perceptions of teacher behavior variables of warmth, demand and utilization of intrinsic motivation. One grcup of undergraduate students received intensive instructional sessions specially designed to affect attitudes and perceptions toward science teaching. The other group's instruction took the form of the usual didactic approach. There were no significant differences between student teachers exposed to an open-learning environment strategy of instruction and those without, but trends in the results of the data analyzed suggested that those trained in an open-learning environment responded positively to the instruments measuring experimentalism, open-mindedness, teacher-pupil relationships and interest in science. (EB)

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THE EFFECTS OF TEACHING SCIENCE METHODS THROUGH AN OPEN LEARNING ENVIRONMENT ON SELECTED ATTITUDES AND PERCEPTIONS OF PROSPECTIVE ELEMENTARY SCHOOL TEACHERS

by
Dr. Charles W. Mitchell
State University of New York
College at Plattsburgh

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The purpose of this paper is to summarize a study which was conducted to explore some alternative organizational patterns for teaching science methods to prospective elementary school teachers.

INTRODUCTION

Essentially three things motivated this study:

(1) The continuing controversy over the necessity for formal methods courses and the organizational pattern of instruction which seems promising;
(2) the paucity of objective data relative to college science methods courses for elementary education majors and
(3) the current interest in the open education movement.

In seeking a point of departure this investigator examined the literature relative to the preceding three statements. Most studies which were looked at tended to be predominately studies of comparison, principally methodology. The pedestrian findings of such studies seemed to indicate that data generated by these studies noted little, if any significant differences among opposing

teaching strategies. The design of these studies failed to incorporate a control group which received no treatment.

There was a conspicuous absence of studies in science education which looked at the prospective teacher as a person and how this person interacted with his classroom environment. Millions upon millions of dollars have been invested in the development of new curricula, new instructional materials and teacher training programs. Yet, where is the needed concern for the interpersonal relationships that are so much a part of the environment of the professional teacher. Numerous studies in the past have concluded that students learn better from teachers who are friendly and sympathetic towards their students. However teacher training institutions have been slow to provide environments where teachers in training become sympathetic and friendly.

To meet the challenge of the present and the uncertainties of the future there is a need for a revolution in attitudes and methods currently fostered in most teacher preparation programs.

Studies related to inquiry climates, (Suchman 1961, 1965, 1967), teacher training at the New School for Behavioral Studies in Education (University of North Dakota) (Silberman, 1970) and the recent reports of the success of the English Infant School (Weber, 1970; Rathbone, 1970; Barth and Rathbone, 1968; Nyquist, 1971, 1970) tend to support an organizational structure for teaching science methods to prospective elementary school teachers based upon a concept commonly referred to as the open learning environment instructional model. Such an organizational model shifts the responsibility of teacher, or methods professor, from a purveyor of information to that of mediator of learning; he joins the students as an inquirer and serves as a resource for the students. The students become a part of an integrated science curriculum set in a free and open learning environment where activities may be structured to fit the learner. The learners may feel free to initiate their learning activities or they may be guided in their investigations by centers or stations which encourage observation and divergent questioning.

DEFINITIONS

OPEN LEARNING ENVIRONMENT - An informal learning environment characterized by self selected integrated science activities. Participants work independently, in pairs, or in small groups on tasks they choose to perform. They are expected to: (1) be engaged in some activity; (2) finish a task before pursuing

another; (3) produce something tangible to account for time spent; (4) be responsible for the care of instructional materials; (5) actively participate in group discussion.

DEMAND - Demand refers to the standards that the teacher sets for each pupil's performance on school tasks. It encompasses the pupil's perceptions of the teacher's level of demand as regards quantity, promptness, correctness, neatness, depth, thoroughness, honesty, attention and orderliness.

INTRINSIC MOTIVATION - Intrinsic motivation as used in this study refers to those motivations which the pupils have internalized and encompasses those teacher behaviors that draw pupils' attention to meaningful relationships between the daily curriculum and selected characteristics (mental, emotional, physical) of the pupils total existence.

PROBLEM

This study was designed to investigate two aspects of the science methods course for elementary school majors. The first measured the effects of three different instructional strategies of teaching science methods on selected attitudes and perceptions held by prospective elementary school teachers. The second dimension measured the effects of these instructional strategies on childrens' interest in science, childrens' science skills and knowledge; childrens' perception of teaching style, and childrens' perception of the teacher behavior variables of warmth, demand and utilization of intrinsic motivation.

The following three instructional strategies were developed and used as a basis for data in this study:

I. An open learning environment where prospective teachers were free to inquire, conceptualize, self-direct their learning activities and to experience structured learning activities where appropriate.

II. A formal lecture-discussion approach where prospective teachers were in a traditional, passive, in-active environment.

III. The classroom teacher situation where the prospective teacher received no treatment.

OBJECTIVES

More specifically the following questions were investigated. Does the type of instructional strategy affect:

(1) perceptions which prospective teachers hold with regard to teacher practices?

(2) the degree of open and closed mindedness of the prospective teachers?

(3) perceptions which prospective teachers hold with regard to teacher-pupil relationships?

(4) the relationship between teacher warmth and childrens' science interests?

(5) gains in the childrens' science knowledge, in understanding of the fundamental science concepts and processes of science?

(6) the perceptions which children have of their prospective teachers' teaching style?

(7) the conceptualizing skills of first grade children?

(8) does the type of instructional strategy stimulate a general interest in science and science related activities among prospective teachers?

RATIONALE

According to Hone (1971) teachers tend to reflect the way they have been taught in their education courses. She also contended that colleges and university courses in elementary science education rarely, if ever, offer prospective teachers a teaching model that can be used in or transferred to the elementary classroom. And in fact, according to Silberman (1970), "there can be no greater demonstration of the irrelevance of most methods courses than the way the methods professors teach."

Furthermore, Brehm (1968), proposed that the roles of the education methods instructors should be:

(1) to provide a different teaching-learning situation than they would experience in science content courses;

(2) to prompt the neophyte teacher to try out new behaviors which reflect the mode of inquiry which the particular science promotes; to create problem situations so that prospective teachers experience different dimensions of thinking which reflect upon his own thinking processes thus he might better understand what it is a learner experiences. Self analysis of his mode of thought and guided interpretations from the science methods instructor will help the prospective teacher to anticipate, in a more natural manner, types of questions his future students might have.

(3) to involve the prospective teacher in identifying and developing skills, both intellectual and manual, which are exemplified in science education.

The discrepancies between what children are expected to learn in science during their elementary school years and the content and professional course

work in the science education of pre-service teachers suggests that we critically examine the science curricula of teacher preparation institutions.

Research studies in science education (Anklam, 1962; Gerne, 1967; Smith, 1966; Bennett, 1965) generally have concerned themselves with data acquired through comparing methods of teaching the same body of content. Irrespective of grade level and subject area there seemed to be no significant difference between the results obtained by using opposing instructional methodology.

Findings in comparative studies which show no significant difference between teaching approaches, the use of any particular visual aids or direct experience in producing gains in childrens' performance clearly indicate the importance of teacher characteristics and behaviors to the whole process of instruction. These findings also point to the danger of imposing a particular procedure upon teachers who do not have the personal characteristics to effectively utilize that procedure.

According to recent research analyses (Ramsey, 1969; Gallagher, 1972), the lack of supportive data for comparative research studies indicates there is a greater need for research into the kinds of instructional procedures which suit different personality types rather than research directed toward trying to determine which procedure is "best" for all teachers.

The National Society for the Study of Education (1947) has pointed out in one of their Yearbooks (46th) that prospective teachers must be given a background of vital experiences in science education so that they may acquire an inner urge and a compulsion to share this with their pupils in the classroom. The Society also emphasized that prospective teachers must want to make learning a cooperative process in which they and the children are continually exploring

their environment in an ever expanding series of pleasurable experiences.

An examination of the curricular structures and objectives of recent innovative elementary school science programs provides evidence for researchers in science education to question the relevancy of current teacher preparation courses which purport how science is to be taught in the elementary school.

The authors of a published report which analyzed 49 research studies on elementary teacher education programs related to the teaching of science (Blosser and Howe, 1969) offered the following prognosis.

> "Areas for study (in science education) should include those concerning the content and experiences to be provided in the preparatory programs, the relationship of the content and experiences to teacher behavior, and the relationship of resulting teacher behavior to the behavior of students in the classroom situation."

The concensus of those charged with the responsibility for preparing science teachers at all levels continues to be that research is badly needed in all areas of elementary school science, but especially in the area of teacher preparation (Winter, 1965).

Although open education has offered some promising organizational strategies for teacher education, valid research is necessary so that the open education concept does not deteriorate and become a cover for those who don't know how to relate to children (and to future teachers) and who are unsure of what is best for the children or prospective teachers. As Ewald B. Nyquist, Commissioner of Education for New York State, stated (Nyquist, 1971):

> "Implementation of open education presents danger and difficulty as well as tremendous opportunity. If educators, children, and parents do not understand it, open education, like progressive education, can easily degenerate into sloppy permissiveness, wistful romanticism, or shallow imitation."

PROCEDURE

To recapitulate, this study was designed to investigate two aspects of the science methods courses designed for those undergraduate students majoring in elementary education. The first aspect measured the effects of three different instructional strategies of teaching science methods on selected attitudes and perceptions held by prospective elementary school teachers. The second dimension measured the effects of the three selected instructional strategies on childrens' interest in science, childrens' science skills and knowledge; childrens' perception of teaching style and childrens' perceptions of teacher behavior variables of warmth, demand and utilization of intrinsic motivation.

SAMPLE

A sample size of thirty undergraduate education students was randomly selected from a total population of forty elementary education majors who would be doing their student teaching during the Fall Semester 1971. Randomization was used for the student teaching placement of the three groups. The public school children who participated in the study were those in classrooms of the prospective teachers who participated in the investigation. Due to the design of the instruments used in this investigation, the grade levels involved were limited to grades 1, 4, 5, and 6.

Each of the three participating methods classes consisted of ten prospective teachers. Two of these classes were located on campus in the local county school system and the third class was located in an off campus center 125 miles from campus. Since the third group received no formal class

instruction regarding methods of teaching science, it served as a control.

The investigation began during the fall student teaching semester and continued for a ten week period of time. All pre-testing was conducted prior to the ten week treatment period.

The treatment of the experimental group, took place during a concentrated block of time, four hours a day for five consecutive days. The activities selected were presented in an open learning environment and were designed to affect the attitudes and perceptions of prospective teachers toward science teaching. This twenty hour concentration was supplemented by ten additional hours of specialized experiences.

The other group located on campus, met weekly during the ten week period of the study. Each instructional session lasted for two and one half hours. The instruction took the form of the usual didactic approach. This group was lectured to on many of the same ideas and concepts which were presented to the experimental group. However, the experimental group encountered the ideas and concepts in the informal open learning environment where discovery and involvement were emphasized. Some interaction was permitted during the instruction to this group but the lessons were dominated by the lecture method. While members of the experimental group had gotten their "hands on" many things, such experiences were demonstrated to the control group with no group involvement. Each group received the same number of clock hours (30) in their treatment.

Participants in the control group off campus were simply instructed that science must be taught in their assigned classrooms during the ten week duration of the study. They were not exposed to any formal science methods instruction and were to use whatever means available to them to teach

science.

All prospective teachers and the children in appropriate classrooms responded to pre-test instruments in September prior to the treatment. (See instrumentation following the section on *FINDINGS*.)

The same battery of instruments were administered to the same populations as post tests at the close of the ten week treatment period. The results were examined for statistical significance at the .05 level.

FINDINGS

No statistical significance, at the .05 level, was noted on all of the hypotheses stated for the prospective teachers. Attempting to expose prospective teachers to an open learning environment strategy of instruction in the final year of their professional education, and without any prerequisite learning for this type of environment may appear to be fruitless.

Nevertheless, the trends in the results of these data analyzed in this study, as indicated by a gain or loss in test score means for within the groups, do offer some evidence for intuitive clinical speculation.

The positive trends indicated for the prospective teachers who experienced the open learning environment and the trends noted for the children in their respective classrooms do offer some encouraging evidence for this type of teaching strategy.

OPEN LEARNING

The experimental group, was the only group which showed a positive trend in mean scores for every instrument to which they responded. A further

examination of test score means for within the experimental group's children showed a positive gain on all of the instruments administered to the children, some being statistically significant. This was the only consistency noted in the study relative to the results of data analyzed for both the prospective teachers and their school children.

The trends indicated by these data seem to suggest that prospective teachers, trained in an open learning environment, responded positively to instruments which measured; experimentalism, open mindedness, teacher pupil relationships, and interest in science. These same prospective teachers can positively affect student interest in science, student perceptions of the teacher behavior variables of demand and utilization of intrinsic motivation, science knowledge and skills, and at least sustain a neutral position relative to the students' perceptions of the teacher's style of teaching.

LECTURE-DISCUSSION

The results of this study indicate that prospective teachers who are trained in a lecture-discussion type of environment, tend to be less open minded than those who received the open learning type of instruction or those who received no formal course work in teaching science methods. They also do not view experimentalism in a very positive fashion. These same prospective teachers also did not perceive their relationship with their pupils in a positive manner. This group showed negative results on the following separate variables; empathy, unconditionality of regard and willingness to be known. Such evidence is not surprising since this group was taught by a lecture-discussion method of instruction. In such an environment there is less interaction among class participants; thus prospective teachers do not get opportunities to practice those behaviors which might be conducive to pupil-teacher interaction. Also

this is the type of instructional strategy that they have been conditioned to over the past fifteen or so years. These prospective teachers were not motivated to share personal feelings and ideas with the instructor nor was sufficient time available to foster attitudes relative to empathy.

NO FORMAL INSTRUCTION

Those prospective teachers who received no formal instruction in the teaching of science in the elementary school showed mean scores which trended in a negative direction. These trends seemed to indicate that children taught by prospective teachers with no formal science methods course and who responded negatively to some of the administered instruments tended to adversely affect the pupils' perceptions of their teacher's style of teaching. According to the results of this study, pupil achievement, as measured by a standardized achievement test does not seem to be adversely affected by the foregoing negative factors. This seems to be consistent, since if achievement - or knowledge - is the central measure, then how one acquires this knowledge is incidental to courses in the methods of teaching.

The scores indicating trends for the teacher behavior variables of demand and utilization of intrinsic motivation were the lowest for this group when compared with the other two groups. The separate variable of demand, however, was statistically significant at the .05 level. This seems to be consistent, in that, the demand factor has already been established in the classroom and if the prospective teacher successfully modeled the cooperating teachers' behavior relative to this variable then the demand variable would show significance for the prospective teachers.

No statistical significance was noted relative to an increase in science

interest among the intermediate grade students in the study. This then would indicate that there was no apparent relationship in this study between the teacher behavior variables and science interest.

Although open learning offers a refreshing change for classroom organization in undergraduate teacher education, it behooves educators, and more particularly science educators, to proceed with caution. We cannot presume that because open education has worked for some educators and under certain conditions, that its organizational structure can be generalized for teacher education or hastily adopted as an answer to all of our educational ills. Much hard research data is needed to substantiate the effectiveness of this approach. We cannot always assume, as we often do, that new strategies or organizational structures will of themselves yield improved or always desirable pupil outcomes.

It may be that if we view the results of the study qualitatively then perhaps the study takes on new significance. Hurd (1971) supported the qualitative view and stated recently that at some points in our research we will need to deal with data in more qualitative terms, using clinical intuition and judgement.

The results gained from this study may indicate that a formal special methods course in the teaching of science in the elementary school can be appropriate and effective in the undergraduate teacher education program when pupil achievement is not considered as the only criterion for measurement. However, the results also indicate that perhaps it is time for a change in the format of professional methods courses. What educators should be looking at are alternatives and options in teacher education rather than comparative strategies. Then the task is to design and test these alternatives. If this challenge is

not undertaken soon then teacher education programs will continue as they are, proliferating "the system", and training purveyors of information rather than teachers of human beings.

IMPLICATIONS FOR TEACHER EDUCATION

In light of the data generated from this study, the following proposals are offered:

(1) If teacher education programs are to change the perceptions of their majors; this change being a necessary prerequisite to any change in behavior, then education majors will have to have more meaningful personal encounters, over longer periods of time. They will have to face, in some cases, experiences which will give them time to formulate, strengthen, or reinforce perceptions relative to themselves, to children, and to others.

The perceptual view of self is central to the education of teachers. Experiences designed to focus on this perceptual view could easily supplant many of the existing courses in education. If one has a positive view of his "self" then he will not need special courses to teach him "how to teach" special subjects.

(2) The data analyzed in this study suggest that the methods courses in the teaching of science at the elementary school level have very little, if any influence on the prospective teacher's predisposition to teach science to children. If a person, teacher or not, likes science, is curious about his world, then he is going to teach science regardless of his formal training experiences. Those not so motivated will avoid teaching science. Therefore, didactic courses which purport to teach methodology should be scruitinized.

carefully.

(3) This study generated some data to lend support for the effects of an open learning environment type of instructional strategy on prospective teachers. It is predicted that with more time and greater scheduling flexibility significant changes in behaviors and attitudes could be observed, both in the prospective teachers and children. The training at the New School for Behavioral Studies at the University of North Dakota (Silberman, 1970) has provided evidence of a limited nature, to give support to the preceding prediction. The fact that this strategy had little if any effect on the attitudes and perceptions of prospective teachers and their children, then it is clear that the implications for further research are apparent.

IMPLICATIONS FOR FURTHER RESEARCH

The results of this study indicate need for the following kinds of research in open education and methods courses in general:

(1) Experimental-analytic types of studies in order to determine; (a) what kinds of "open classroom" experiences produce the best socio-emotional learning climate for developing maximum pupil cognitive and emotional growth at all levels. In such studies the sequence of activities and their time span could be experimentally controlled.

(2) Observational-analytical studies utilizing some of the observational devices currently available and to develop new ones which can be utilized to more accurately record non-verbal behavior and to be able to assess quantitatively pupil creativity, pupil autonomy and the child's relationship with the materials of the learning environment.

(3) A research design which would empirically determine what combination of new and old strategies for instruction yield optimum student growth. Some examples might be, what combination of lecture-demonstration, highly structured, independent, pre-determined and open experiences produce better learners. Such a design should examine and test alternatives to or options for present teacher education programs.

(4) A research design which would replicate this study but collect additional data such as demographic variables on the cooperating teachers and the prospective teachers in the study. Such variables could include information relative to training in science, their culture, and experiential background.

(5) A research design which places prospective teachers in a public elementary school open learning environment for their "on-the-job training" in contrast to the open learning type of strategy which was employed in this study.

INSTRUMENTAION

Prospective Teachers

Reed Science Activity Inventory, Part I. The Reed Inventory, Part I is composed of 70 science acitivity items, accompanied by a six point frequency scale for each item. Although the vocabulary and selection of activities were designed for respondents in grades 7-10, the author of the test contends that it can be used at other levels. This instrument was chosen to measure the prospective teachers' interest in science before treatment and was applied following treatment to determine if the strategy of instruction had any measureable on interest in science.

Personal Beliefs Inventory used in this study measures how a teacher feels about creating conditions which enhance self educational activity or learning and how the teacher cooperates with those activities of the students so that they have learning as their consequences.

Teacher Practices Inventory was used in this study to measure what the respondent perceives as to what a teacher does in a classroom.

The Relationship Inventory used in the study was developed by Barrett-Leonard (1962) in an attempt to connect cause and effect in the therapy process. It was used to measure teacher-pupil relationships as perceived by the prospective teacher and specifically was concerned with the following characteristics: level of regard, congruence, empathic understanding, unconditionality of regard and willingness to be known. The rationale for using this inventory in this study was that the teacher's perception of his relationships with the class was reflected by his behavior in the classroom and that behavior influenced pupils' interest and achievement in science.

The Personal Opinion Questionnaire used in this study is the same instrument as the Dogmatism Scale developed by Rokeach. This scale was used to measure the open and closed mindedness of the prospective teachers. Research with the Dogmatism Sacle as reported by Rokeach indicates:

(1) high dogmatism restricts creativity;

(2) high dogmatism is related to anxiety;

(3) high dogmatism subjects reveal a greater need for closure than low dogmatic (open minded) persons. The D-Scale was used in this study to measure the relationship between open and closed mindedness and the type of learning climate established by the prospective teachers, the attitudes of their pupils

toward science, and the science skills and knowledge attained by the pupils.

Children

Reed Science Activity Inventory, Part I. See previous description. A valid measurement of interest is one that obtains a score based upon a respondent's statements concerning the degree of actual participation in selected activities.

Reed Science Activity Inventory Part II is composed of a random ordering of teacher behavior items. These provide scores for the three teacher behavior variables of warmth, demand and utilization of intrinsic motivation.

Sequential Test of Educational Progress (STEP), Science, Form 4A. A standardized test for children in grades 4-6. It provided a measure of the following: knowledge, comprehension, application and higher abilities.

Student Perception of the Teacher Style (SPOTS) Inventory is an instrument designed to measure teacher directiveness. The form modified for this study was used to determine whether prospective teachers trained in an open learning environment affect the pupils' perceptions of the teaching style as compared to those in the control groups.

Concept Prerequisite and Development Test (CPDT), Form A. The CPDT is a valid, reliable standardized instrument which should prove useful in measuring concept prerequisite and development skills possessed by first grade children. Specifically it accomplishes this by providing a measure of the child's ability to; attend to a task, to logically remember, to detect similarities, to detect differences and to use these skills in the conceptualizing process.

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